TEST LABORATORY

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No. L7/4/2000

TEST REPORT

IEC 60269-2-1

Low-voltage fuses. Part 2: Supplementary requirements for fuses for use by authorized persons
(fuses mainly for industrial application)
Section I – fuses with fuse links with blade contacts

Report reference No	:150/LLP-086/95
Compiled by (+ signature)	:Krzysztof Białynicki - Birula:
Approved by (+ signature)	:Boleslaw Wybraniak, PhD:
Date of issue	: 07.11.1995 (of the Polish original).
Testing laboratory	: Laboratorium Badawcze Oddzialu IEI w Gdańsku
Address	: Narwicka 1, 80-557 Gdansk, Poland, tel. +48 58 343 06 45
Testing location	: see above, fax:+48 58 343 12 95:
Test sample(s) received	: 24.09.1995
Tested in period	: September - October, 1995
Applicant	:APATOR S.A.
Address	:Żółkiewskiego 13/29, 87-100 Toruń, Poland
Standard	: IEC 60269-2-1:1987 (see also IEC 60269-1:1986
Test Report Form No.	: I269201A/96-08 (adapted for fuse-bases by editor of this report)
Master TRF	: dated 91-10
TRF originator	: EZU
Copyright blank test report	: The bodies participating in CCB and/or CCA. This report is based on a blank test report that was prepared by KEMA using information obtained from the TRF originator.
Test procedure	: IEC 269-2-1:1987 and IEC 269-1:1986 [idt. Polish Std. PN-91/E-06160/21 and PN-91/E-06160/10]
Procedure deviation	: No
Non-standard test method	: No
Type of test item	: fuse-base for fuse-links with blade contacts
Trademark	: APATOR S.A
Model/type reference	: PBD 00
Manufacturer	: APATOR S.A. Żółkiewskiego 13/29, 87-100 Toruń, Poland
Rating	: 160A, 660V

Note:

These test results refer to the object tested. The test report shall not be reproduced except in full without the written approval of the test laboratory.

Client is allowed to use the following statement:
"This test has been carried out in Test Lab of Gdańsk Branch of the Electrotechnical Institute, Poland, accredited by Polish Centre of Testing and Accreditation, certificate No. L 7/4/2000."

Copy of marking plate
Test item particulars: - Fuse-holder ..... : ~~Yes~~/No - Fuse-base ..... : ~~Yes~~/~~No~~ - Fuse-carrier ..... : ~~Yes~~/No - Fuse-link ..... : ~~Yes~~/No
Possible test case verdicts: - test case does not apply to the test object ..... : N(.A.) - test object does meet the requirement ..... : P(ass) - test object does not meet the requirement ..... : F(ail)
General remarks: "(see remark #)" refers to a remark appended to the report. "see appended table)" refers to a table appended to the report. Throughout this report a comma is used as the decimal separator. The Clauses of the standard IEC 60269-1 are marked with the letter G(eneral)
List of appended: table(s) No. ..... to ..... photo(s) No. ..... to ..... diagram(s): No. ..... to ..... records(s) No. b1002 , ...

TEST PROGRAM

Standard Clause:	Verification name	Test result
5	CHARACTERISTIC OF FUSES	P
6	MARKING	P
7, G7	STANDARD CONDITIONS AND CONSTRUCTION	P
7.1	The dimensions of the fuse base	P
G8.2	Verification of insulating properties	P
G8.3	Verification of temperature rise and power dissipation	P
G8.5	Verification of breaking capacity	P
8.5.5.1	Verification of the peak withstand current of a fuse-base	N (see above)
G8.8	Verification of the degree of protection of enclosures	P
8.9	Verification of resistance to heat	P
8.10	Verification of non-deterioration of contacts	P
8.11.1.2	Mechanical strength of the fuse-base	P
8.11.2.4	Non-deterioration of insulating parts of fuse link and fuse base	P
G8.11.2.2	Verification of resistance to abnormal heat and fire	P
G8.11.2.3	Verification of resistance to rusting	P

Cl.	Requirement - Test	Result	Verdict
5.	CHARACTERISTICS OF FUSES		—
G5.2	Rated voltage (V) as specified ..... :	U_i = 660V	P
5.3.1	Rated current (A) of the fuse-link and the size of the fuse-link as specified in Fig. 1 (I) (IEC 269-2-1):	160A 00	—
5.3.2	Rated current (A) of the fuse-holder and the size of the fuse-link as specified in Fig. 2 (I) (IEC 269-2-1):	160A 00	—
5.5	Rated power (W) dissipation of fuse-link within specified limits (IEC 269-2-1, Fig. 2 (I)) ..... :	—	—
	Rated power (VA) acceptance of fuse-holder within specified limits (IEC 269-2-1, Fig. 1 (I)) ..... :	12 W	P
G5.7.2	Rated breaking capacity (kA) of fuse-link a.c. corresponds to the rated voltage (V), and is equal or higher than given minimum (A) in subsequent part of this standard ..... :	100kA / 500V	—
	Rated breaking capacity (kA) of fuse-link d.c. corresponds to the rated voltage (V), and is equal or higher than given minimum (A) in subsequent part of this standard ..... :	—	N

6.	MARKING		—
G6.1	Fuse-holder marked by:		—
	- name of manufacturer or trade mark which enables identification of fuse-holder ..... :	APATOR	—
	- manufacturer's identification reference enabling to find all characteristics listed in 5.1.1 ..... :	PBD 00	—
	- rated voltage (V) ..... :	660V	—
	- rated current (A) ..... :	160A	—
	- kind of current and rated frequency (Hz) ..... :	~	—
	Markings are legible	YES	P
6.1	Fuse-holder without fuse-links: the marking of the rated current and rated voltage discernible from the front	YES	P
6.2	Fuse-link: the marking of the rated voltage and rated current discernible from the front	—	N

7.	STANDARD CONDITIONS FOR CONSTRUCTION		—
7.1	The dimensions of the fuse-links in tolerances given in Fig. 1 (I) (IEC 269-2-1)		
	Deviations:		—
	dimension marking a1: prescribed (mm); measured (mm) ..... :		—
	dimension marking a2: prescribed (mm); measured (mm) ..... :		—
	dimension marking a3: prescribed (mm); measured (mm) ..... :		—

Cl.	Requirement - Test	Result	Verdict
	dimension marking a4: prescribed (mm); measured (mm) ..... :		—
	dimension marking b: prescribed (mm); measured (mm) ..... :		—
	dimension marking c1: prescribed (mm); measured (mm) ..... :		—
	dimension marking c2: prescribed (mm); measured (mm) ..... :		—
	dimension marking d: prescribed (mm); measured (mm) ..... :		—
	dimension marking e1: prescribed (mm); measured (mm) ..... :		—
	dimension marking e2: prescribed (mm); measured (mm) ..... :		—
	dimension marking e3: prescribed (mm); measured (mm) ..... :		—
	dimension marking e4: prescribed (mm); measured (mm) ..... :		—
	dimension marking f: prescribed (mm); measured (mm) ..... :		—
	The dimensions of the fuse-base in tolerances given in Fig. 2 (I) (IEC 269-2-1)		—
	Deviations:		—
	dimension marking h: prescribed (mm); measured (mm) ..... :	—	—
	dimension marking n1: prescribed (mm); measured (mm) ..... :	—	—
	dimension marking n2: prescribed (mm); measured (mm) ..... 38 max ..... :	32,9	P
	dimension marking p1: prescribed (mm); measured (mm) ..... :	—	—
	dimension marking p2: prescribed (mm); measured (mm) ..... :	—	—
	dimension marking r: prescribed (mm); measured (mm) ..... :	—	—
	dimension marking s: prescribed (mm); measured (mm) ..... :	—	—
	dimension marking t: prescribed (mm); measured (mm) ..... :	—	—
	dimension marking v: prescribed (mm); measured (mm) without fuse link-covers (enclosures) 56,5 ± 1,5	58,05	P
	dimension marking v: prescribed (mm); measured (mm) with fuse link-covers (enclosures)..... :	—	—
	dimension marking w2: prescribed (mm); measured (mm) ..... 25 ± 0,7 ..... :	24,0	P
	dimension marking x: prescribed (mm); measured (mm) ..... 14 min ..... :	13,82	P

Cl.	Requirement - Test	Result	Verdict
	dimension marking y: prescribed (mm); measured (mm) ..... 7,5 ± 0,5 ..... :	7,15	P
	dimension marking z: prescribed (mm); measured (mm) ..... :		—
7.1.2	Terminals for unprepared copper conductors enable to accept min. and max. cross-sectional areas of conductors as stated in Table D (IEC 269-2-1)..... :	YES	P
	Size of sample ..... :	Size 00	—
	Terminals capable to accept conductors of cross-sectional areas from (mm^2) to (mm^2) ..... :	mm^2 / mm^2 10/70	P
	Terminals suitable for Cu conductors	YES	—
	Terminals suitable for Cu and Al conductors	—	—
7.1.3	Contact silver plated ..... :	Yes ~~No~~	—
	if no see 8.1 of IEC 269-1	—	N
7.1.7	Fuse-link has an indicator	—	N
G7.1.1	Replacing of the fuse-link easy and safe	YES	P
G7.1.2	Contact force is not transmitted through insulating material other than ceramic or other material with characteristics not less suitable, unless	YES	P
	there is sufficient resilience in the metallic parts to compensate any possible shrinkage or other deformation of the insulating material	YES	P
	Terminals cannot turn or be displaced when the connecting screws are tightened	YES	P
	Terminals shall be such, that the conductors cannot be displaced	YES	P
	Parts gripping the conductors are of metal	YES	P
	Gripping parts cannot unduly damage conductors	YES	P
	Terminals readily accessible under the intended conditions of installation	YES	P

8.	TESTS		—
8.1.6	Testing of fuse-holders	See program, page 2	—

G8.2	Verification of insulating properties		—
G8.2.1	The fuse-holder fitted with a fuse-link(s) of the largest dimensions for the type of fuse-holder	YES	—
	The fuse-base fixed to a metal plate, unless otherwise specified	YES	—
G8.2.2	The test voltage shall be applied between:		—
	a) live parts and the frame with the fuse-link and the device for replacing it, or	YES	—

Cl.	Requirement - Test	Result	Verdict
	~~the fuse-carrier, if any, in position~~		—
	no breakdown of insulation or flashover during 1 min of the applying test voltage	YES	P
	b) the terminals without fuse-link, device for replacing or the fuse-carrier	YES	—
	no breakdown of insulation or flashover during 1 min of the applying test voltage	YES	P
	c) live parts of different polarity in the case of multi-pole fuse-holder with fuse-link(s), fuse-carrier(s) or device(s) for replacing the fuse-links	—	—
	no breakdown of insulation or flashover during 1 min of the applying test voltage	—	N
	d) live parts which in the case of a multi-pole fuse-holder reach different potential after the fuse-link operates (equipped by fuse-carrier or device for replacing without fuse-link)	—	—
	no breakdown of insulation or flashover during 1 min of the applying test voltage	—	N
G8.2.3	The r.m.s. value of test voltage (V) as specified in Table IX ..... :	2500V	—
G8.2.4.2	The fuse-holder subjected to humidity treatment under specified conditions	YES	—
	Relative moisture of ambient air (%) ..... :	91-95	—
	Ambient air temperature (°C)..... :	23-27	—
	Duration of treatment (h) ..... :	48	—
	The insulation resistance measured between points prescribed in 8.2.2 by applying a d.c. voltage of 500/~~1000 V~~	500	—
	Points of measuring:		—
	a) min. measured value (MΩ) ..... :	>100	P
	b) min. measured value (MΩ) ..... :	>100	P
	c) min. measured value (MΩ) ..... :	>100	P
	d) min. measured value (MΩ) ..... :	—	N
	The insulation resistance not less than 5 MΩ	YES	P

G8.3	Verification of temperature rise and power dissipation		—
G8.3.1	One fuse used for test (unless otherwise stated by the manufacturer) mounted in free air	YES	—
	Test performed at an ambient air temperature of 20 ± 5 °C	YES	—
	Ambient air temperature during the test (°C) ..... :	17	—
	Terminals screws; diameter (mm) ..... :	M8	—
	Tightened by torque; torque (Nm) ..... :	10	—

Cl.	Requirement - Test	Result	Verdict
G8.3.2	The temperature of the fuse measured by method of measuring ..... :	termoelements	—
G8.3.4.1	Temperature rise of the fuse-holder	Table 1	—
	Measured on sample as stated in Table VIII	—	—
	Applied a.c. current (A) for test equal to the rated current of the fuse-holder ..... :	160	—
	Test made with fuse-link (A), or ..... :	—	
	with a dummy fuse-link specified in subsequent part of IEC 269 ..... :	Part 2-1 160A ; 047mΩ	—
	Temperature rise ~~limits T for contacts and terminals~~ (Table IV):		—
	spring loaded contacts; limit (K) ..... :	unenclosed / enclosed	—
	bolted contacts; limit (K) ..... :	unenclosed / enclosed	—
	terminals; limit (K) ..... 70 ..... :	42 ; 45K	P
G8.3.4.2	Power dissipation of a fuse-link	—	—
	The test made with a.c. at the current (A) equal to the rated current of the fuse-link ..... :	—	—
	The points of measuring ..... :	—	—
	Measured value of power (W) dissipation in limits (W) specified in subsequent parts of IEC 269 ..... :	Part —	—
G8.3.5	The rated power (W) acceptance of fuse-holder not less than the rated power dissipation of the corresponding fuse-link ..... 12W ..... :	12,4	P
	After the tests prescribed in 8.3, the insulating parts of the fuse-holder cooled to ambient temperature withstood the test voltage according to 8.2	YES	P
	No deformations after tests of 8.3	YES	P

G8.5	Verification of breaking capacity		—
	The test arrangements as specified in 8.1.4 and 8.5.1	YES	—
G8.5.2	Characteristics of the test circuit as specified	in the Std.	—
	Scheme of test circuit	—	—
	Deviations form specified characteristics of test circuit ..... :	one phase test	—
G8.5.4	Calibration of test circuit	after the Std.	—
	Calibration oscillograms and their evaluation	94kA r.m.s	—
G8.5.6	The breaking-capacity tests made at an ambient air temperature of 20 ± 5 °C	18°C	—
	Breaking-capacity tests on a.c. fuses		—
G8.5.5.1	Table XIIA, test No. 1 for "g" and "a" fuse-links		—
	Rated breaking capacity of the fuse-links (kA), at voltage (V) ..... :	100kA / 500V	—

Cl.	Requirement - Test	Result	Verdict
	Rated current (A) of the fuse-links ..... :	160	—
	Prospective current I1 (kA) equal to rated breaking capacity within a tolerance of + 10%, - 0% ..... :	94kA	—
	Power factor ..... :	0,1	—
	Initiation of arcing after voltage zero: within 40° - 65° for sample 1 and within 65° - 90° for sample 2 and 3, or ..... :	1) 2) 3) —	N
	for sample 1) arcing after voltage zero within 0° + 10°, - 0° ..... :	—	N
	Power frequency recovery voltage: voltage (V) i.e (%) of rated voltage within 110% + 5%, - 0% of the rated voltage ..... :	1) 2) 3) —	N
	Cut-off current (kA) ~~pole L1; L2; L3~~.....page 14: .....~~page 15~~:	1) 14,1 ~~2)~~ ~~3)~~	P
G8.5.8	Acceptability of No. 1 test results:		—
	a) max. arc voltage (V) did not exceed stated values of 7.5 (Table V) ..... :	—	N
	b) fuse-links operated without external effects or damage to the components of the complete fuse	YES	P
	c) no permanent arcing, flashover or ejection of dangerous flames	YES	P
	d) no damage of fuse components hindering from their further use	YES	P
	e) no damage of fuse-link such, that it is difficult or dangerous to replace them	YES	P
	f) fuse-link remains in one piece before its removal from the fuse- carrier	YES	P
	g) resistance (MΩ) between contacts of fuse-links after test not less than 50 000 Ω for the rated voltage of fuse-links to 250 V, 100 000 Ω in all other cases :	1) 2) 3) —	N

8.5.5.1	Verification of the peak withstand current of a fuse-base	verified in breaking test	—
	The fuse-bases withstood the peak current (kA) as stated in Table G (IEC 269-2-1) ..... :		—
	The fuse-links not ejected		—
	~~No signs of arcing or welding~~, no damage to prevent ~~further~~ use of fuse-base		—

G8.8	Verification of the degree of protection of enclosures		—
	Degree of protection IP ..... :	IP 20	—
	Verification by test under conditions specified in IEC 529 ..... :	YES	—
	The enclosure satisfies the test of relevant degree of protection	YES	P

Cl.	Requirement - Test	Result	Verdict
8.9	Verification of resistance to heat		—
8.9.1.1	Fuse-base fitted with dummy fuse-link in accordance with Fig. 5 (I) (IEC 269-2-1)	of 0,47mΩ	—
	The cross-sectional area (mm²) of attached conductors (the length 1 m min.) in accordance with Table X of IEC 269-1	70	—
8.9.1.2	The fuse-base with dummy fuse-link located in heating chamber at the temperature 80 + 5 °C, - 0 °C for 2 h without loading, after that next 2 h at the same temperature but loaded with 160% of rated current (A) i.e. ..... :	256A	—
	After loading and 3 min after switching off, a tensile force Fmax (N) (see Table J) is applied to the dummy, duration of exerted force 15 s (Fig. 8 (I) (IEC 269-2-1) ..... 60N ..... :	YES	P
8.9.1.3	After the test the contact pieces did not move to such an extent as to affect further use of the fuse-base	YES	P
	The insulating mounting parts are without any signs of cracks and not broken	YES	P

8.10	Verification of non-deterioration of contacts		—
8.10.1	Three samples provided with standardised dummy fuse-links (Fig.5(I))of the highest current rating (A) intended to be used in the fuse-holder (Fig.6(I)):	of 0,47mΩ	—
8.10.2	Test current (A) for load period ..... :	200A	—
	Duration (s) of load period ..... :	30 min	—
	Duration (s) of non-load period ..... :	12 min	—
	a) Test of 50 cycles, measured resistance of contacts R_{50}, see appended table	0,533mΩ	—
	b) Test of 250 cycles, measured resistance of contacts R_{250}, see appended table	0,539mΩ	—
8.10.3	Acceptability of results $\frac{R_{250} - R_{50}}{R_{50}} \leq 15\%$	1,1%	P

8.11.1.2	Mechanical strength of the fuse-base		—
	The forces for withdrawal of test-link from tested fuse-bases lie within the limits as specified in Table J of IEC 269-2-1	YES	P
	Measuring device in accordance with Fig. 8 (I) (IEC 269-2-1)	YES	—
	Size of sample ..... :	Size 00	—

Cl.	Requirement - Test	Result	Verdict
	Specified force for withdrawal min. (N)/max. (N); measured force (N) .....60-250..... :	1) 79N; 70N; 71N 2) 121N; 111N; 79N 3)	P
	Size of fuse-base fitted with steel screws ..... :	Size 00	—
	The screws fastened three times by applying a torque 1,2 times the torque (Nm) as stated in Table F, i.e. (Nm)	12Nm	—
	After the test are the contact pieces without dislocation, or	YES	P
	not moved in such an extent as to affect further use of the fuse-base	YES	P
	The insulating mounting parts are without any signs of cracks and not broken	YES	P

8.11.2.4	Non-deterioration of insulating parts of fuse link and fuse base		—
	Three fuse-bases comprising moulded elements intended to support live parts exposed for a period of 168 h to a temperature of 150 ± 5 °C	YES	—
8.11.1.2	The forces for withdrawal of test-link from tested fuse-bases lie within the limits as specified in Table 3 of IEC 269-2-1	—	—
	Measuring device in accordance with Fig. 8 (I) (IEC 269-2-1)	—	—
	Size of sample ..... :	Size 00	—
	Specified force for withdrawal min. (N)/max. (N); measured force (N) ..... :	1) 2) — 3)	—
8.11.2.4.2	Acceptability of test results:		—
	no changes of fuse-base contacts affecting correct function	YES	P
	insulating body without signs of a fracture	YES	P
	the mechanical strength of cemented joints not impaired	—	N
	sealing compounds shall not have shifted to an extent permitting live parts to be exposed	—	N
	the marking durable and easily legible	YES	P

G8.11.2.2	Verification of resistance to abnormal heat and fire		—
G8.11.2.2.1	Parts of insulating material, except ceramic, have a limited duration of burning without spreading fire by flames or burning droplets or glowing particles falling from the specimen	YES	P

Cl.	Requirement - Test	Result	Verdict
G8.11.2.2.5	Glow-wire test: 650 ± 10 °C		–
	Parts of insulating material not necessary to retain current-carrying parts in position even though they are in contact with them, satisfy the glow-wire test 650 ± 10 °C		
	No visible flame, or burning or glowing of the specimen extinguish within max. (s) after removal of the glow-wire. Limit 30 s ± 1 s .....:		
	No burning of the tissue paper		
	No scorching of the pinewood board		
	Glow-wire test: 960 ± 10 °C	insulation base	–
	Parts of insulating material not necessary to retain current-carrying parts in position even though they are in contact with them, satisfy the glow-wire test 960 ± 10 °C	YES	P
	No visible flame, or burning or glowing of the specimen extinguish within max. (s) after removal of the glow-wire. Limit 30 s ±1 s .....:	YES	P
	No burning of the tissue paper	YES	P
	No scorching of the pinewood board	YES	P

G8.11.2.3	Verification of resistance to rusting		–
	Tested parts after degreasing (10 min in specified solution) placed for 10 min in air saturated with moisture and after that dried 10 min in an ambient temperature 100 ± 5 °C	YES	P

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Laboratorium      Biegun S
Badawcze IEL OG     Uskut=554.   V
95-11-07, 13:38     Iskut=100.   kA
Próba b1002        cos φ=0.25
                  |I max|=14.1   kA
                  |U max|=312.   V
                    ∫i²dt=136E3  A²s
                   p∫i²dt=4.05E3 A²s
                   ₐ∫i²dt=126E3  A²s
                    ∫uidt=40.5E3 VAs
                     ∫idt=22.1   As
                      wop=0.10
                       wp=1.04
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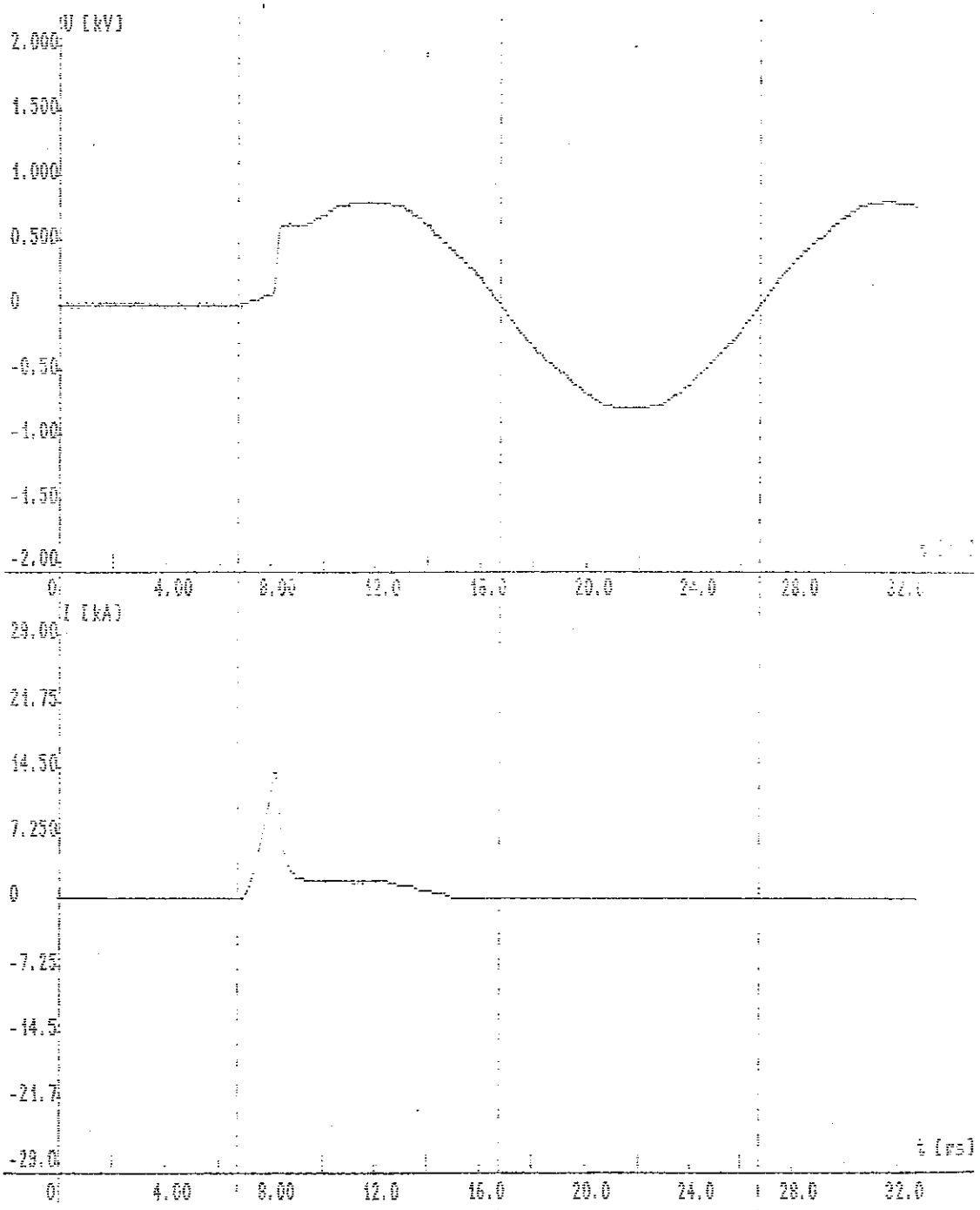

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